## REMARKS

The specification has been amended to remove various informalities, and claims 1, 6, 9-12, 17, 18 and 23 have been amended. Entry of the foregoing amendments and reconsideration of the present application are respectfully requested.

A Substitute Original Declaration accompanies this response, to address the issue raised in paragraph 1 of the Office Action.

In the Office Action, the specification is objected under 37 CFR 1.71 because the specification as originally filed fails to provide an adequate written description of the invention. This objection is traversed, inasmuch as the claims form a part of the original specification, and the claims provide a complete written description of the invention. If there are any portions of the claims that are not specifically included in the specification and the PTO wishes to have the Applicants insert corresponding language into the specification, Applicants are prepared to do so upon request. If the written description objection is based only on the issue raised in paragraph 4 of the Office Action, Applicants have clarified the description, as will be explained below.

Further, claims 1, 3-18 and 20-23 were rejected under 35 U.S.C. 112, first paragraph, as being indefinite for the reason set forth in paragraph 4 of the Action. In addition, claims 1, 3-9, 17 and 23 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

First, Applicants have amended the description to clarify the invention as it is set forth in the description, particularly, the dispersion within ± % has been corrected to within %. This amendment would be supported by, for instance, the equation: Dispersion [%] = {(maximum value -minimum value)/ (maximum value + minimum value)} x 100, which is set forth on page 10, lines 14-15 or the original specification.

Consistent with the clarification to the specification, Applicants have amended claims 1, 6, 9-12, 17-18 and 23 to overcome the rejections of under 35 U.S.C. 112, first paragraph and second paragraph. Based on these clarifying amendments, it is

believed that the present application is in full compliance with Section 112 and the Patent Rules.

Next, the Applicants describe the present invention by way of background. One object of the invention is to provide a sputtering target that, in applying the dual damascene interconnection technology to form an Al interconnection film, enables improved electrical characteristics and quality of a Nb liner film of the Al film. In particular, the object is to provide a Nb sputtering target that enables one to obtain, with reproducibility, a Nb film capable of suppressing the increase in resistivity of an Al interconnection film to, for instance, $4\mu\Omega$ cm or less and the occurrence of dust.

As the result of extensive studies, the inventors have found that, in the high purity Nb sputtering target, the dispersion of Ta in the Nb target, the Nb grain size and the grain size ratio of adjacent grains in the Nb target, and the dispersion of oxygen in the Nb target are important parameters for solving the above problems.

A sputtering target of claim 1 of the present application is a high purity Nb sputtering target comprising a Ta content of 3000 ppm or less, the dispersion of Ta content in the sputtering target being within 30%. For example, as shown in Table 1 on page 21 of the specification, when the content of Ta in the target is 3000 ppm or less and the dispersion of the Ta content is within 30%, the resistivity of an Al alloy interconnection film having the Nb liner film formed by the target can be reduced in resistivity.

A sputtering target of claim 18 is a high purity Nb sputtering target comprising an oxygen content of 200 ppm or less, the dispersion of the oxygen content being within 80%. As shown in Table 3, the interconnection film having a Nb liner film formed by the Nb sputtering target satisfying the requirement of claim 18 can be reduced in resistivity. Product yield can thereby be largely improved.

A sputtering target of claim 10 is a high purity Nb sputtering target comprising Nb grains having a grain diameter in the range of 0.1 to 10 times the average grain diameter, and a grain size ratio of adjacent grains in the range of 0.1 to 10. As is apparent from Table 5 on page 28, in the Nb film deposited with the present Nb sputtering target satisfying the requirement of claim 10, it is found that there is no occurrence of giant dust particles.

In the Office Action, the PTO has rejected claims 1, 3-18 and 22-23 under 35 U.S.C. 103 as being unpatentable over Ohhashi et al (USP. 5693203 (col.6, lines 32-63), JP 04099171 (abstract) or JP 4308081 (abstract).

In making this rejection, the PTO expressly notes the deficiencies of the prior art references, but bases the rejections on the notion that the previous claims were capable of being read on zero amounts of Ta and O. While Applicants do not necessarily agree that this is the proper interpretation for the previous claims, they have nevertheless adopted a claim format which clearly precludes such an interpretation. For this reason alone, the rejections should be reconsidered and withdrawn.

Furthermore, the Office Action grounds its reasoning in part on the principle that "optimization of a variable recognized in the art as a result-effective variable normally is considered to be within the ordinary skill in the art." While Applicants do not quarrel with the statement of the principle, they do point out that the present record is devoid of any evidence that those skilled in this art recognized that the claimed parameters were "result-effective" for the results sought after by the Applicants. Thus, this principle of law has no application to the present context.

Column 6, lines 33-62 of Ohhashi et al. discloses a sputtering target made of a material selected from W, Mo, Ti, Ta, Zr and Nb, a backing plate made of a material selected from Ti or Ti alloys, and the target having a uniform microstructure having crystal grain sizes of no more than 350/am.

As mentioned above, a sputtering target of claim 18 claims that Nb grains have a grain diameter in the range of 0.1 to 10 times an average grain diameter, and a grain size ratio of adjacent grains is in the range of 0.1 to 10. Therefore, since Ohhashi et al. fails to teach or suggest a sputtering target of claim 10, Ohhashi et al. is clearly distinguishable from the sputtering target of claim 10 of the present application.

JP 04-099171 discloses an **Al alloy** sputtering target containing Ta, Nb, and/or V. However, this reference fails to teach or suggest a high purity Nb sputtering target (as that term is clearly understood by persons skilled in the art). Therefore, this reference is clearly distinguished from the present invention.

JP 04-308081 discloses a sputtering target in which a plurality of target pieces each having different compositions are combined, integrated, and disposed on a substrate to form a sputtering target. As a target piece, Nb is disclosed. However, this reference fails to teach or suggest a Nb sputtering target claimed in claims 1, 10, and 18. Therefore, this reference is also clearly distinguished from the present invention.

In view of the forgoing amendments and comments, Applicants respectfully request reconsideration and withdrawal of the various rejections based on the prior art.

Consequently, further and favorable consideration of the application, in the form of a Notice of Allowance of all claims is believed to be next in order, and such action is respectfully solicited. In the event that one or more minor matters remain for resolution, the Examiner is invited to telephone the undersigned at the number given below.

Respectfully submitted,

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By _____

Richard L. Schwaab
Attorney for Applicant
Registration No. 25,479

FOLEY & LARDNER
Washington Harbour
3000 K Street, N.W., Suite 500
Washington, D.C. 20007-5109
Telephone: (202) 672-5414
Facsimile: (202) 672-5399

**MARKED-UP PORTIONS OF SPECIFICATION AND CLAIMS SHOWING CHANGES MADE**

IN THE SPECIFICATION:

Page 4, lines 7-11:

A first sputtering target of the present invention is characterized in consisting essentially of high purity Nb of which Ta content is 3000 ppm or less. The first sputtering target is further characterized in that [dispersion of Ta contents over the whole target is within ± 30%] the dispersion of the Ta content in the target is within 30%.

Page 4, lines 12-19:

A second sputtering target of the present invention is characterized in consisting essentially of high purity Nb wherein each grain of the Nb has a grain diameter in the range of 0.1 to 10 times an average grain diameter and ratios of grain diameters of adjacent grains are in the range of 0.1 to 10. The second sputtering target is further characterized in that [dispersion of the ratios of grain diameter of adjacent grains over the all target is within ±30%] the dispersion of the grain size ratio between adjacent grains in the target is within 30%.

Page 4, lines 20-24:

A third sputtering target of the present invention is characterized in consisting essentially of high purity Nb of which the oxygen content is 200 ppm or less. The third target is further characterized in that [dispersion of the oxygen contents over the whole target is within ± 80%] the dispersion of the oxygen content in the target is within 80%.

Page 5, lines 11-19:

In the third sputtering target, a content of oxygen as an impurity is set at 200 ppm or less. Further, the [dispersion of the oxygen content over the whole target is set within ± 80%] dispersion of the oxygen content in the target is set within 80%. A reduction of the oxygen content in the high purity Nb target enables to suppress a

content of oxygen in a Nb film deposited therewith. Thereby, $Ta_2O_5$ causing an increase of the resistivity in the interconnection film can be suppressed from generating, resulting in realization of low resistivity of the interconnection film.

Page 9, lines 15 to 21:

[Dispersion of the Ta content in the target of the present sputtering target is preferable to be within ± 30% as a whole target. Thus, by suppressing the dispersion of the Ta content low in the target, the resistivity over the whole interconnection film formed therewith can be lowered with reproducibility. The dispersion of the Ta content over the whole target is further preferable to be within ± 15%] Dispersion of the Ta content in the target of the present invention is preferably to be within 30%. Thus, by suppressing the dispersion of the Ta content low in the target, the resistivity over the whole interconnection film formed therewith can be lowered with reproducibility. The dispersion of the Ta content in the target is further preferable to be within 15%.

Page 9, line 22 to page 10, line 2:

[Dispersion of the oxygen content in the sputtering target of the present invention is preferable to be within ± 80% as the whole target. Thus, by suppressing the dispersion of the oxygen content low in the target, the resistivity over the whole interconnection film formed therewith can be lowered with reproducibility. The dispersion of the oxygen content over the whole target is further preferable to be within ± 50%, and still further preferable to be within ± 30%.] Dispersion of the oxygen content in the sputtering target of the present invention is preferably to be within 80%. Thus, by suppressing the dispersion of the oxygen content low in the target, the resistivity over the whole interconnection film formed therewith can be lowered with reproducibility. The dispersion of the oxygen content in the target is further preferably to be within 50%, and still further to be within 30%.

Page 10, line 28 to page 11, line 5:

The present sputtering target consisting of high purity Nb is further preferable to control the size of the Nb grains constituting the target in the following way. That is, a grain diameter of each grain is in the range of 0.1 to 10 times an average grain diameter and [ratios of grain diameters of adjacent grains] a grain size ratio of adjacent grains is in the range of 0.1 to 10.

Page 12, line 26 to page 13, line 5:

The dispersion of the grain size ratio[s] of [the] adjacent grains in the target is preferable to be within [±] 30% [the target as a whole]. Thus, by suppressing the dispersion of the grain size ratio[s] low in [over] the [whole] target, the Nb film can be suppressed from the occurrence of giant dusts [deposited therewith as a whole can suppress the giant dust from occurring]. The dispersion of the grain size ratio[s] of [the] adjacent grains in the sputtering [over the whole] target is preferable to be within [±] 15%, and further preferable to be within [±] 10%.

Page 13, lines 1625:

The dispersion of the grain size ratio[s] denotes a value obtained in the following ways. For instance, for analysis, 9 specimens are sampled from a surface of the sputtering target of a diameter of 320 to 330 mm. The specimens each are sampled from the center of the target and positions located at 75 mm and 150 mm from the center in directions of X-axis and Y-axis relative to the center, respectively. The grain size ration is measured of each of these 9 specimens for analysis. The dispersion is obtained from the maximum and minimum values thereof with the following formula.

Page 13, line 28 to page 14, line 8:

For the Nb grains in the sputtering target, as mentioned above, the grain size ratio between the adjacent grains are particularly important to be in the range of 0.1 to 10. However, when the [total] dispersion of the grain diameter[s] of the Nb grains is large, there are many grains different in sputtering rate to result in larger steps between the adjacent grains. Accordingly, the grain diameters of the Nb grains are set in the range of 0.1 to 10 times an average grain diameter.

Page 16, line 28 to page 17, line 12:

The sputtering target of the present invention, though capable of using for forming interconnection films of various kinds of electronic devices, can be particularly preferably used in forming a Nb film as liner material to an Al film (or Al alloy film). A Nb film sputter deposited with a sputtering target of the present invention is 3000 ppm or less in Ta content, and further 2000 ppm or less, 1000 ppm or less, and the dispersion [thereof] of the Ta content in the target is within [±] 30%, and further within [±] 15%. The oxygen content is 200 ppm or less, and further 150 ppm or less, 100 ppm or less, and the dispersion [thereof] of the oxygen content is within [±] 80%, further within [±] 50%, and furthermore within [±] 30%. In addition, the number of the dust particles (giant dust in particular) is remarkably scarce.

Page 25, Table 3:

Table 3

| Target No. | Oxygen Content (ppm) | Dispersion of Oxygen Content (%) | Resistivity of interconnection (μ Ω cm) |
|---|---|---|---|
| No. 1 | 10 | [±]82 | 4.2 |
| No. 2 | 10 | [±]40 | 3.0 |
| No. 3 | 50 | [±]23 | 3.1 |
| No. 4 | 60 | [±]64 | 3.1 |
| No. 5 | 100 | [±]27 | 3.2 |
| No. 6 | 110 | [±]68 | 3.4 |
| No. 7 | 140 | [±]38 | 3.5 |
| No. 8 | 320 | [±]31 | 4.1 |
| No. 9 | 630 | [±]22 | 4.4 |
| No. 10 | 820 | [±]20 | 4.7 |

IN THE CLAIMS:

1. (Twice Amended) A sputtering target [consisting essentially] of high purity Nb, [of which Ta content is] comprising an amount of Ta, wherein the Ta content is 3000 ppm or less, wherein a dispersion of the Ta content in [over] the [whole] target is within [±] 30%, the dispersion of the Ta content being defined by the following equation, for measured content values in the target:

dispersion (%) = {(maximum value - minimum value) / (maximum value + minimum value)} X 100.

6. (Amended) The sputtering target as set forth in claim 1:
wherein each grain of [the] Nb has a grain diameter in the range of 0.1 to 10 times an average grain diameter, and [each of] a grain size ratio [ratios of grain sizes] of adjacent grains is in the range of 0.1 to 10.

9. (Amended) The sputtering target as set forth in claim 1:
wherein the sputtering target is applied [in forming] to form a Nb film [as] for a liner [material to] of an Al interconnection film or an Al alloy interconnection film.

10. (Amended) A sputtering target [consisting essentially] of high purity Nb:
wherein each grain [of the Nb] constituting the Nb target has a grain diameter in the range of 0.1 to 10 times an average grain diameter, and [each of ratios of grain sizes] a grain size ratio of adjacent grains is in the range of 0.1 to 10.

11. (Twice Amended) The sputtering target as set forth in claim 10:
wherein a dispersion of the [ratios of gain sizes of the] grain size ratio of adjacent grains [all over] in the target is within [± 30%] 30%,
wherein the dispersion of the grain size ratio of the adjacent grains is defined by the following equation, for measured values in the target:

dispersion (%) = {(maximum value - minimum value) / (maximum value + minimum value)} X 100.

12. (Amended) The sputtering target as set forth in claim 10:

wherein [each of the ratios of grain sizes] the grain size ratio of the adjacent grains is in the range of 0.5 to 5.

17. (Amended) The sputtering target as set forth in claim 11:
wherein the sputtering target is used [in forming] to form a Nb film [as] for a liner [material to] of an Al interconnection film or an Al alloy interconnection film.

18. (Twice Amended) A sputtering target [consisting essentially] of high purity Nb, [of which oxygen content is] comprising an amount of oxygen, wherein the oxygen content is 200 ppm or less, wherein a dispersion of the oxygen content [over] in the [whole] target is within [± 80%] 80%, the dispersion of the oxygen content being defined by the following equation, for measured values in the target:

dispersion (%) = {(maximum value − minimum value) I (maximum value + minimum value)} X 100.

23. (Amended) The sputtering target as set forth in claim 18:
wherein the sputtering target is used [in forming] to form a Nb film [as] for a liner [material to] of an Al interconnection film or an Al alloy interconnection film.